

REMARKS

This is intended as a full and complete response to the Final Office Action dated October 1, 2003. Please reconsider the claims pending in the application for reasons discussed below.

Claims 1, 4-24 and 74-109 are pending in the application. Claims 1, 4-24 and 74-109 are rejected.

An inventor declaration under 37 C.F.R. § 1.132, signed by Li-Qun Xia, a person skilled in the art, is submitted along with this response.

In the final office action, claims 1 and 4-10 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication No. 20020068458A1 (*Chiang*), in view of U.S. Patent Publication No. 20020081855 (*Jiang*). The Examiner states that *Chiang* describes a method of thin film deposition for integrated circuit fabrication comprising providing a substrate and treating the substrate with a plasma prior to forming an organosilicate layer. The Examiner further states that *Jiang*, at least in paragraph 13, teaches that the H₂O₂ plasma chemistry is an equivalent plasma chemistry known in the art wherein the plasma is generated in a reaction chamber by applying an electric field to a gas mixture comprising molecular oxygen (O₂) and molecular hydrogen (H₂). The Examiner asserts that it would have been obvious for one of the ordinary skill in the arts at the time of the invention to substitute *Jiang's* method of the H₂O₂ plasma chemistry and wherein the plasma is generated in a reaction chamber by applying an electric field to a gas mixture comprising molecular oxygen (O₂) and molecular hydrogen (H₂) for *Chiang's* process steps to reduce or eliminate the resist poisoning.

Chiang discloses a method to perform an in-situ clean/surface treatment to a surface prior to an ALD deposition. *Chiang* discloses the use of atomic hydrogen or halogen-containing radicals to react with the surface contaminants, such as oxides to form oxygen containing byproducts, which are then easily pumped away (paragraph 25). *Jiang* discloses the use of an oxygen (O₂) plasma to reduce or eliminate the poisoning of resist. *Jiang* further discloses alternative plasma chemistries may be used, such as H₂, H₂O, H₂O₂, O₃, CO, CO₂, SO₂, etc. with or without gas additive like Ar or He (paragraph 13). *Jiang* does not teach that generating a plasma from H₂O₂ or H₂O is an

equivalent known in the art to generating plasma from a gas mixture comprising molecular oxygen (O_2) and molecular hydrogen (H_2). *Jiang* teaches forming a plasma by the use of O_2 , O_3 , H_2 , H_2O_2 or H_2O amongst others and never in combination.

In the Advisory Action, the Examiner asserts “generating plasma from H_2O_2 or H_2O is equivalent to generating plasma from a gas mixture comprising molecular oxygen and molecular hydrogen.” Further, the Examiner states, “when plasma is applied to H_2O_2 it will disassociate to form molecular oxygen and hydrogen.” Applicant respectfully traverses the unopposed finding of fact.

According to the Declaration under 37 C.F.R. § 1.132 by Li-Qun Xia, a person skilled in the art would realize generating a plasma from H_2O_2 or H_2O is not equivalent to generating plasma from a gas mixture comprising molecular oxygen and molecular hydrogen. The Declaration further states that a person skilled in the art would realize when plasma is applied to H_2O_2 , the disassociation products will be hydroxyl radicals (OH) and hydrogen radicals (H), not molecular oxygen (O_2) and hydrogen (H_2).

Therefore, *Chiang* and *Jiang*, alone or in combination, do not teach, show or suggest a method of thin film deposition for integrated circuit fabrication comprising providing a substrate, treating the substrate with a plasma prior to forming a organosilicate layer, wherein the plasma is generated in a reaction chamber by applying an electric field to a gas mixture comprising molecular oxygen (O_2) and molecular hydrogen (H_2) forming the organosilicate layer on the substrate and treating the organosilicate layer with the plasma, as recited in claim 1, and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Claims 11-24 and 74-109 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Chiang* and *Jiang*, as applied to claims 1, 4-10 above, further in view of U.S. Patent Publication No. 20020142579A1 (*Vincent*). The Examiner states *Chiang* and *Jiang* do not describe, yet *Vincent* does describe that the second gas mixture comprises a silicon source, a carbon source and an oxygen source and applying an electric field to that second gas mixture in the deposition chamber forms the carbon-containing silicate layer on the substrate. The Examiner asserts that it would have been obvious to one of ordinary skill in the art at the time of the invention to include *Vincent*'s

steps of the second gas mixture with the process derived by combining *Chiang* and *Jiang* as discussed above. Applicant respectfully traverses the rejection.

Vincent discloses forming low dielectric constant interlayer materials by use of organosilicon precursors. The combined references do not suggest applying an electric field to a mixture of molecular oxygen (O₂) and molecular hydrogen (H₂) since *Vincent* adds nothing to the other references which are discussed above. Therefore, *Vincent*, *Chiang* and *Jiang*, alone or in combination, do not teach, show or suggest a method of thin film deposition of an organosilicate layer comprising positioning a substrate in a deposition chamber, providing a gas mixture to the deposition chamber, wherein the gas mixture comprises a silicon source, a carbon source and an oxygen source, applying an electric field to the gas mixture in the deposition chamber to form the organosilicate layer on the substrate and treating the organosilicate layer with a plasma, wherein the plasma is generated by applying a second electric field to a second gas mixture comprising molecular oxygen gas and molecular hydrogen gas, as recited in claim 74, and claims dependent thereon. Withdrawal of the rejection is respectfully requested. Also, *Vincent*, *Chiang* and *Jiang*, alone or in combination, do not teach, show or suggest a method of thin film deposition of an organosilicate layer comprising positioning a substrate in a deposition chamber, depositing the organosilicate layer from a gas mixture, wherein the gas mixture comprises a silicon source, a carbon source and an oxygen source and treating the organosilicate layer with a plasma, wherein the plasma is generated by applying an electric field to a second gas mixture comprising molecular oxygen gas and molecular hydrogen gas, as recited in claim 96, and claims dependent thereon. Applicant further traverses the rejection of dependent claims 11-24 on the grounds stated above. Withdrawal of the rejection is respectfully requested.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show or suggest the invention as claimed.

Having addressed all issues set out in the office action, Applicant respectfully submits that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
Nemani, et al.

Serial No.: 09/820,463

Confirmation No.: 5650

Filed: March 28, 2001

For: PLASMA TREATMENT OF
ORGANOSILICATE
LAYERS

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Group Art Unit: 2814

Examiner: Shrinivas H. Rao

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

CERTIFICATE UNDER 37 CFR 1.10	
I hereby certify that this correspondence and the documents referred to as attached therein are being deposited on <u>April 30, 2004</u> with the United States Postal Service in an envelope as "Express Mail Post Office to Addressee," mailing label No. <u>EV331233547US</u> addressed to: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.	
<u>4/30/04</u> Date	<u>[Signature]</u> Signature

DECLARATION UNDER 37 C.F.R. § 1.132

I hereby declare as follows:

1. That I, Li-Qun Xia, am a manager of the Low K group of Applied Materials, Inc. I have over 9 years of experience in the semiconductor equipment industry. My responsibility includes developing processes for plasma treatment and material deposition for the Low K group.
2. That I have a B.S. in Chemical Engineering from the East China Institute of Chemical Technology and a Ph.D. in Chemical Engineering from the Cornell University focused on Kinetics and Dynamics of Silicon Epitaxial Growth Using Molecular Beam.
3. That I am an inventor of United States Patent Application Serial No. 09/820,463, filed March 28, 2001, and have read the application (herein '463).

4. That the specification of the '463 application clearly states the parameters necessary to practice the described plasma treatment method. Specifically, the specification identifies wafer temperatures, chamber pressures, gas flow rates for an oxygen (O₂) and hydrogen (H₂) gas, and radio frequency power to ignite the plasma. As such, a person skilled in the art would realize the method described in '463 application will produce a plasma mixture containing both H-radicals (H) and O radicals.
5. That I have read the specification of United States Patent Application Serial No. 09/966,605, filed September 28, 2001, as published as United States Patent Publication No. 20020081855 (herein '605).
6. That I, a person skilled in the art of semiconductor wafer processing and, specifically, in the art of plasma treatment of materials, having read '605 (in particular, paragraphs 11-31), and conclude that the method described in '855 will not produce a plasma mixture containing substantial amounts of oxygen radicals (O).
7. That I have read the Advisory Action, dated January 5, 2004, for the '463 application.
8. That I, a person skilled in the art of semiconductor wafer processing and, specifically, in the art of plasma treatment of materials, having read the Advisory Action (in particular, the Examiner's note on the Continuation Sheet), disagree with the Examiner's statements. First, the Examiner asserts "generating plasma from H₂O₂ or H₂O is equivalent to generating plasma from a gas mixture comprising molecular oxygen and molecular hydrogen." A person skilled in the art would realize generating a plasma from H₂O₂ or H₂O is not equivalent to generating plasma from a gas mixture comprising molecular oxygen and molecular hydrogen. Secondly, the Examiner states, "when plasma is applied to H₂O₂ it will disassociate to form molecular oxygen and hydrogen." A person skilled in the art would realize when plasma is applied to H₂O₂, the disassociation

products will be hydroxyl radicals (OH) and hydrogen radicals (H), not molecular oxygen (O₂) and hydrogen (H₂).

9. That all statements made herein of my own knowledge are true and that these statements made on information and belief are believed to be true and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent resulting therefrom.

4/27/04

Date



Signature